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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KEVIN CINK, JEFFREY C. SMITH,
JAMES F. NANGERONI, and JED RICHARD RANDALL

Appeal 2010-010505
Application 10/593,111
Technology Center 1700

Before TONI R. SCHEINER, DONALD E. ADAMS, and
STEPHEN WALSH, *Administrative Patent Judges*.

WALSH, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134(a) involving claims to an extruded polylactide foam and a process for preparing it. The Patent Examiner rejected the claims as obvious. We have jurisdiction under 35 U.S.C. § 6(b). We affirm-in-part.

STATEMENT OF THE CASE

Claims 24 and 27-32 are on appeal. Claims 24, 27, 28, 30 and 31 are representative and read as follows:

24. An extruded foam prepared according to the process of claim 28 wherein the foam has a crystallinity of about 13-24 J/g, as measured by differential scanning calorimetry.

27. A process that comprises forming a pressurized, molten mixture of a melt processable polylactide resin containing about 5 to about 15% by weight, based on the weight of the polylactide resin, of carbon dioxide, and extruding the molten mixture at an extrusion temperature through a die to a region of reduced pressure such that the carbon dioxide expands and the polylactide resin simultaneously cools to form a stable foam having at least 70% closed cells, wherein the polylactide resin contains at least 80% by weight polymerized lactic acid units.

28. The process of claim 27, comprising the further step of heat treating the foam to induce crystallinity.

30. The process of claim 27, wherein the pressurized, molten mixture contains 7-11 % by weight by weight CO₂, based on the weight of the polylactide resin in the mixture.

31. The process of claim 27, wherein the extrusion temperature is from about 70 to about 140°C.

The Examiner rejected the claims as follows:

- claims 24, 27-30 and 32 under 35 U.S.C. § 103(a) as unpatentable over Hammel¹ and Shinohara;² and
- claim 31 under 35 U.S.C. § 103(a) as unpatentable over Hammel, Shinohara, and Morita.³

¹ US Patent No. 5,134,171 issued to Howard S. Hammel et al., Jul. 28, 1992.

² JP 2003-073495 issued to Shinohara, Mar. 12, 2003.

OBVIOUSNESS

The Issue

The Examiner's Rejections

The Examiner's position is that Hammel disclosed a polyhydroxy acid foam produced by an extrusion process, comprising polylactic acid, with a blowing agent that may be carbon dioxide. (Ans. 4-5.) The Examiner found that Hammel's foam polymer composition of the polyhydroxy acid foam comprised from 50-97% of the L enantiomer of lactic acid, with additional lactic acid units having the D enantiomeric configuration. (*Id.* at 4.) The Examiner found that 90% of Hammel's cells were closed before shaping, above 50% were closed after shaping, and the formed foam was subjected to heat treatment after the extrusion process. (*Id.* at 4-5.)

Regarding the amount of blowing agent, the Examiner found that Hammel disclosed an example incorporating 5 wt% blowing agent into molten polylactic acid. (*Id.*) Therefore, according to the Examiner, it would have been obvious to a skilled artisan at the time of the invention to incorporate 5 wt% carbon dioxide blowing agent into Hammels' molten polylactic acid polymer. (*Id.*)

Regarding crystallinity, the Examiner found that a skilled artisan would have expected the Hammel's composition to have the claimed crystallinity because its compositions comprised the same amounts of L and D configurations of polylactic acid, the same amount of carbon dioxide blowing agent, and were subjected to heat after being formed. (*Id.*) However, the Examiner found that Hammel did not expressly teach that its

³ US Patent No. 5,238,968 issued to Kenji Morita et al., Aug. 24, 1993.

foam comprised from 5 to 15% or from 7 to 11% carbon dioxide (as recited in instant claim 30) or that its foam had a crystallinity of 13-24 J/g as measured by differential scanning calorimetry (as recited in instant claim 24). (*Id.*)

The Examiner found that Shinohara taught an amorphous polylactide foam comprising from 2 to 20 wt% carbon dioxide foaming agent and a crystallinity of 15 or more J/g, as measured by differential scanning calorimetry. (*Id.* at 6.) According to the Examiner, it would have been obvious to a skilled artisan at the time of the invention to use the amount of carbon dioxide taught by Shinohara in the invention of Hammel to improve the die shape reproducibility and weld nature of the polylactic acid resin, as taught by Shinohara. (*Id.*)

Regarding claim 31, the Examiner found that Hammel and Shinohara did not expressly teach an extrusion temperature from 70° to 140°C. (*Id.*) However, the Examiner found that Morita disclosed a process for preparing foam comprising polylactic acid and carbon dioxide. (*Id.*) The Examiner also found that Morita's process comprised "extruding the composition at a temperature of from 100°C to 270°C, ... which overlaps the instantly claimed extrusion temperature of instant claim 31." (*Id.*) According to the Examiner, it would have been obvious for the skilled artisan to use the extrusion temperature taught by Morita in the process of Hammel because Morita taught that extrusion temperatures lower than 100°C and over 270°C are unfavorable. (*Id.* at 7.)

Appellants' Contentions

Regarding claims 27 and 32, Appellants contend that "Hammel fails to describe a polylactide extrusion foaming process, in which 5 to 15% of

carbon dioxide, based on the weight of the resin, is used as the blowing agent.” (App. Br. 7-8.) According to Appellants, Hammel only exemplifies carbon dioxide in one example in which the concentration is 0.44% by weight and does not provide any suggestion to use a greater amount. (*Id.* at 8.) Additionally, Appellants assert that “Shinohara does not describe any extrusion foaming process at all, and therefore provides no reason whatsoever to modify the teachings of the Hammel reference.” (*Id.*)

Regarding claim 24, Appellants contend that Hammel does not describe crystalline foams. (*Id.* at 10.) Appellants assert that crystallinity is not an inherent part of the extrusion foaming process, rather, “crystallization develops mainly in a subsequent heat-annealing step.” (*Id.*) Appellants assert that Shinohara’s teachings regarding crystallinity “apply to the resin by itself, not the ultimate foam.” (*Id.* at 11.)

Regarding claims 28 and 29, Appellants contend that these claims are not obvious over the prior art because neither Hammel nor Shinohara taught a post-extrusion heat treatment step to induce crystallinity into the foam. (*Id.*)

Regarding claim 30, Appellants contend that the claim is not obvious over the prior art because Hammel did not describe using more than 5% of any blowing agent, much less 7 to 11% of carbon dioxide, as required by claim 30. (*Id.*) Appellants again assert that Shinohara does not relate to extrusion foaming processes. (*Id.* at 12.)

Regarding claim 31, Appellants contend that Morita does not overcome the deficiencies of Hammel and Shinohara with respect to the limitations of claim 27, from which claim 31 depends. (*Id.*)

The issues with respect to these rejections are whether the record supports a conclusion that a foam containing 5 to about 15% carbon dioxide would have been obvious; and

whether the evidence supports a finding that foam suggested by the prior art would have had a crystallinity of about 13-24 J/g.

Findings of Fact

1. We agree with the Examiner's explicit findings regarding the scope and content of the prior art references (*see* Ans. 3-7) with the following exceptions:
2. Shinohara disclosed a bead foaming process that is distinct from the extrusion foaming process disclosed in Hammel. (*See* Shinohara [0011]-[0020].)
3. Shinohara disclosed obtaining the crystallinity of its resin as 15 or more J/g, rather than the crystallinity of the foam product. (*See id.* at [0011].)

Principles of Law

In an obviousness analysis "all disclosures of the prior art... must be considered." *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976).

Analysis

Claims 27 and 32

We are not persuaded by Appellants' contention (App. Br. 7-8) that it would not have been obvious to use about 5% by weight, based on the weight of the polylactide resin, of carbon dioxide. Hammel disclosed

preparing a mixture of a polylactide resin with a blowing agent. (Ans. 5.) Hammel also disclosed that suitable blowing agents include carbon dioxide. (*Id.*) Further, Hammel disclosed examples comprising various amounts of the blowing agent, including what amounted to about 5 wt% based on the weight of the polylactide resin. (*Id.*) We agree with the Examiner that these disclosures by Hammel alone would have suggested adding 5% by weight of carbon dioxide to Hammel's mixture. (*See id.*) The fact that Hammel disclosed an example using a smaller amount of carbon dioxide does not negate this suggestion. Nor is the suggestion of using 5% of a blowing agent limited to the particular blowing agent, HFC-134a, exemplified in the disclosure example. *See Lamberti*, 545 F.2d at 750 (obviousness analysis considers all disclosures of prior art).

Accordingly, we affirm the rejection of claims 27 and 32.

Claims 24, 28 and 29

Claims 28 and 29 require the process of preparing an extruded foam to include "the further step of heat treating the foam to induce crystallinity." (App. Br. Claims App'x. 1.) Claim 24 recites an extruded foam prepared according to the process of claim 28 and further requires the foam to have a crystallinity of about 13-24 J/g. (*Id.*)

We are not persuaded by Appellants' contention that Hammel's post-extrusion heat step does not induce some crystallization of the foam product. Indeed, as Appellants have asserted, "crystallization develops mainly in a subsequent heat-annealing step." (App. Br. 10.) Accordingly, we affirm the rejections of claims 28 and 29.

However, given the undisputed facts Appellants refer us to in their Specification, showing the time and heat required for different degrees of

crystallinity to develop, we agree with Appellants that Hammel's disclosure is insufficient evidence to find that Hammel's foam necessarily had a crystallinity of about 13-24 J/g, as required by claim 24. We also agree with Appellants that Shinohara's teaching relating to crystallinity "appl[ied] to the resin by itself, not the ultimate foam." (*Id.* at 11.) Accordingly, we reverse the rejection of claim 24.

Claim 30

While we have found that that Hammel suggested using about 5% of carbon dioxide as a blowing agent, we agree with Appellants that the reference did not suggest using an amount of 7-11% by weight of carbon dioxide, as required by claim 30. We also agree with Appellants that Shinohara disclosed using a bead foam process but the Examiner did not establish that a skilled artisan would have combined steps from a bead foam process with Hammel's extrusion process as the rejection proposed. (*See* App. Br. 5-6, 12; Reply 1-2.) Accordingly, we reverse the rejection of claim 30.

Claim 31

Appellants contend that claim 31 would not have been obvious over the prior art for the same reasons discussed regarding the rejection of claim 27, from which claim 31 depends. Further, Appellants assert that Morita does not overcome the deficiencies of Hammel and Shinohara. As discussed, we found that claim 27 would have been obvious to the skilled artisan at the time of the invention over Hammel alone. For the same reason, we are not persuaded by Appellants' contention regarding claim 31. Accordingly, we affirm the rejection of claim 31.

CONCLUSIONS OF LAW

The record supports the Examiner's conclusion that the prior art would have made the processes recited in claims 27, 28, 29, 31 and 32 prima facie obvious.

However, the record does not support the Examiner's conclusion that the prior art would have made the extruded foam recited in claim 24 or the process recited in claim 30 prima facie obvious.

SUMMARY

We reverse the rejection of claims 24 and 30 under 35 U.S.C. § 103(a) as unpatentable over Hammel and Shinohara;

we affirm the rejection of claims 27, 28, 29 and 32 under 35 U.S.C. §103(a) as unpatentable over Hammel and Shinohara; and

we affirm the rejection of claim 31 under 35 U.S.C. § 103(a) as unpatentable over Hammel, Shinohara, and Morita.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED-IN-PART

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